Rhizofiltration for Treatment of Oil and Gas Produced Water

An Honors Thesis (HONR 499)

by

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Abstract

Production of conventional oil, natural gas and coal bed methane is often accompanied by the release of large volumes of oil and gas produced wastewater (PW). Numerous incidents are documented annually in the United States where PW is released to local environments from well blowouts and via damaged pipelines. There is a need to formulate an effective means of treating PW following a release. The reported project involves the use of a hydroponics system to assess the ability of four plant species (sunflower, *Helianthus annuus*; Indian mustard, *Brassica juncea*; cattail, *Typha latifolia*; and sedge, *Carex blanda*) for rhizofiltration treatment of synthetic PW. After reaction with PW for nine weeks, *Brassica juncea* was most effective in removal of sodium from the PW. All species accumulated more metals in roots compared to aboveground shoots. *Helianthus annuus* were the most effective at translocation of metals to the shoots, regardless of complete plant death by five weeks. Based on current findings, several green plants may serve as a low-cost, environmentally benign method for treatment of PW.

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Process Analysis Statement

Beginning a research thesis is no easy task. There were many steps involved, and it is not possible to do so on your own. I really enjoyed the process of carrying out my research thesis, and I found it to be a rewarding experience. Over the course of three years, I was able to acquire the basic knowledge needed to carry out a preliminary research thesis.

I started working the in Department of Natural Resources during my sophomore year as a research assistant on an Undergraduate Research Fellowship with Dr. John Pichtel. Our main focus was studying how plants and soil were affected by anthropogenic chemicals and contaminants. We focused on hydraulic fracturing fluid (HFF), which is used in hydraulic fracturing (i.e. fracking) operations to recover oil and natural gas. This liquid requires a significant range of chemicals (several potentially toxic), and we were interested as to how this mixture affects the environment. Furthermore, when the oil extraction processes cease, the HFF is often improperly disposed onto the land. There has been significant research on how HFF affects ground and surface water, but limited research regarding its affect on soils. We carried out two different projects with the goals of understanding: (1) how HFF affects the soil; and (2) the potential of green plants to take up metals and hydrocarbons from HFF into their roots and shoots, a process known as phytoremediation. The potential for plants to serve as a method for soil remediation is timely because of the increasing use of HFF in oil extraction combined with the lack of previous research.

I worked on this project for most of my sophomore year, and it extended into my junior year. The next project involved use of constructed wetlands, which involved studying the potential of water-based plants to treat HFF. This project gave me more experience with quality assurance/quality control plus the use of analytical instruments required for metal detection.